

I. THE CLAIMED INVENTION

An exemplary embodiment of the claimed invention, as defined by, for example, independent claim 1, is directed to an electric power steering apparatus adapted to transmit power supplied from an electric motor for assisting steering. The electric power steering apparatus includes a driving gear and a driven gear through which the power is transmitted. A first backlash between the driving gear and the driven gear in a first range of steering angles, including a steering neutral position, is smaller than a second backlash in a second range of steering angles. At least one of the driven gear and said driving gear comprises a bias portion that sets the first backlash. The driven gear includes the bias portion formed by biasing a part of an outer periphery of teeth in a direction in which the first backlash is decreased.

Conventional electric power steering apparatuses try to strike a balance between a large backlash which reduces resistance to steering assistance, but which increases the amount of noise due to steering feedback from the tires of the vehicle, and a small backlash which increases resistance to steering assistance, but which reduces the steering feedback noise. However, these systems have provided a backlash which provides a proper balance.

In stark contrast, the present invention provides a proper balance by providing a first backlash between the driving gear and the driven gear in a first range of steering angles, including a steering neutral position, is smaller than a second backlash in a second range of steering angles. In this manner, the present invention may obtain the benefits of a smaller backlash in the neighborhood region of a steering neutral position and the benefits of a larger backlash in a remaining region. Thus, the present invention both reduces resistance to steering assistance from a steering assist motor and also suppresses noise due to steering

feedback from the tires. (Page 2, line 22 - page 3, line 22).

In the “Response to Remarks” section of the April 28, 2006, Office Action, the Examiner alleges that “biasing a part of an outer periphery of teeth in a direction in which . . . backlash is decreased is broad.” (Emphasis original).

Firstly, however, whether or not a claimed invention “is broad” is irrelevant to whether such an invention is patentable. U.S. Patent Law does not permit the Examiner to deny any patent applicant a patent simply because the Examiner is of the opinion that a claimed invention “is broad.”

Secondly, contrary to the Examiner’s apparent misunderstanding of the claims, none of the claims recite “biasing a part of an outer periphery of teeth in a direction in which . . . backlash is decreased.”

Rather, the claims recite, for example, providing a first backlash between the driving gear and the driven gear in a first range of steering angles, including a steering neutral position, is smaller than a second backlash in a second range of steering angles. In this manner, a backlash between the driving gear and the driven gear in a range of steering angles including a steering neutral position is set relatively small so that noises produced during straight travel can be prevented, and the backlash in the other range of steering angles is set relatively large so that the increase in the resistance torque can be suppressed.

Applicants respectfully request that the Examiner refer to the claim language when evaluating the patentability of the claims.

II. THE PRIOR ART REJECTIONS

A. The Mizukoshi et al. reference

Regarding the rejection of claims 1, 3-10, 12-15, 17-18, and 20-31, the Examiner alleges that the Mizukoshi et al. reference teaches the claimed invention. Applicants submit, however, that there are elements of the claimed invention which are neither taught nor suggested by the Mizukoshi et al. reference.

None of the applied references teaches or suggests the features of the claimed invention including a first backlash between the driving gear and the driven gear in a first range of steering angles, including a steering neutral position, is smaller than a second backlash in a second range of steering angles. As explained above, this feature is important for reducing resistance to steering assistance from a steering assist motor and also suppressing noise due to steering feedback from the tires.

The Mizukoshi et al. reference very clearly does not teach or suggest anything at all about a backlash in a first range of steering angles being different than any other range of steering angles, let alone that a backlash in a range near a steering neutral position is smaller than a remaining steering operational range.

Rather, the Mizukoshi reference teaches a variable gear ratio steering gearing. In particular, the Mizukoshi et al. reference teaches a variable gear ratio steering gearing that has a gear ratio that increases as the steering angle increases. (Col. 1, lines 59 through 66).

The examiner alleges that the Mizukoshi et al. reference discloses a bias portion in which a first backlash is decreased with respect to a second backlash and cites column 3, lines 27 through 28 in an attempt to support that allegation. However, contrary to the examiner's allegation the Mizukoshi et al. reference does not support the examiner's allegation.

Rather, column 3, lines 27 through 28 of the Mizukoshi et al. reference only discloses that an appropriate backlash can be maintained in engagement with the sector gear. In other words, the Mizukoshi et al. reference teaches that the backlash may be adjusted such that it is consistent (i.e. the same) across all operating angles.

The Mizukoshi et al. reference does not teach or suggest that the backlash changes, let alone changes with respect to the steering angles, or changes such that a first backlash and a range of steering angles including a steering in neutral position is smaller than a second backlash in a second range of steering angles, as recited by the claims.

The examiner also attempts to allege that the Mizukoshi et al. reference discloses that the driven gear and the worm wheel are inherently offset from each other. However, the Mizukoshi et al. reference does not teach or suggest that the driven gear and that driven wheel and the worm wheel are inherently offset from each other.

“To establish inherency, the extrinsic evidence must make clear that the missing descriptive matter is necessarily present in the thing and described the reference, and that it would be so recognized my persons of ordinary skill. Inherency, however, may not be established by probabilities or possibilities.

The mere fact that a certain thing may result from a given set of circumstances is not sufficient.”

“In relying upon the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the end allegedly inherent characteristic necessarily flows from the teachings of the applied prior art.” (Emphasis original, M.P.E.P. section 2112.IV.).

In the present instance, the examiner has failed to prove that the driven gear and the worm wheel are necessarily offset from each other. Indeed, the examiner has not even attempted to provide a basis in fact and/or any technical reasoning to reasonably supports the examiner's allegation that the driven gear and the worm wheel are inherently offset from each other.

The Mizukoshi et al. reference does not teach or suggest anything at all regarding a driven gear and a worm gear being offset from each other.

Additionally, the examiner has failed to present a *prima facie* case for obviousness.

“To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of the success.

Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.” (Emphasis added, M.P.E.P. section 2143).

Indeed, the examiner admits that the examiner has failed to present a *prima facie* case for obviousness because the examiner admits that the Mizukoshi et al. reference “does not specify a first backlash and a first range of steering angles, this backlash being less than a second backlash and a second range of steering angles.”

Applicants respectfully request withdrawal of the rejection of claims 1, 3-10, 12-15, 17-18, and 20-31.

B. The Mizukoshi et al. reference in view of the Kojo et al. reference

Regarding the rejection of claim 32, the examiner alleges that the Kojo et al. reference would have been combined with the Mizukoshi et al. reference. Applicants respectfully submitted that the applied references do not teach or suggest the features of the claimed invention and that one of ordinary skill in the art would not have combined these references.

None the applied references teaches or suggests the features of the claimed invention including a first backlash between the driving gear and the driven gear is smaller in a first range of steering angles than a second backlash in a second range of steering angles. This feature is important for reducing resistance to steering assistance from a steering assist motor and also suppressing noise due to steering feedback from the tires.

As explained above, the Mizukoshi et al. reference does not teach or suggest these features.

The Kojo et al. reference does not remedy the deficiencies of the Mizukoshi et al. reference.

Rather, the Kojo et al. reference discloses a steering apparatus with a controller that controls the transmission ratio in order to control the effects of motor inertia.

The Kojo et al. reference does not mention anything at all that is even remotely related to backlash, let alone disclose a bias portion that sets backlash, or at least one of a driving gear and a driven gear that has a bias portion which sets the backlash between the driving gear and the driven gear at least in a neighborhood region of a steering neutral position to be smaller than that in a remaining region.

Indeed, the Examiner does not allege that the Kojo et al. reference teaches or suggests anything at that is even remotely related to backlash.

Further, Applicants submit that these references would not have been combined as alleged by the Examiner. Indeed, the references are directed to completely different matters and problems.

The Mizukoshi et al. reference is concerned with the problem of providing a variable gear ratio steering gear incorporating a sector gear which has sufficient strength and an ideal tooth form for an engagement with the ball nut. (Column 1, lines 19 through 24).

In stark contrast, the Kojo et al. reference is concerned with the completely different and unrelated problem of motor inertia which is sensed by a driver manipulating the steering wheel which adversely affects steering feeling. (Col. 1, lines 19-27).

One of ordinary skill in the art who was concerned with the problem of providing a variable gear ratio steering gear incorporating a sector gear which has sufficient strength and an ideal tooth form for an engagement with the ball nut, as the Mizukoshi et al. reference is concerned, would not have referred to the Kojo et al. reference and vice-versa because the Kojo et al. reference is directed to the completely different and unrelated problem of motor inertia which is sensed by a driver manipulating the steering wheel which adversely affects steering feeling. Thus, the references would not have been combined.

Therefore, the Examiner is respectfully requested to withdraw the rejection of claim 32.

III. FORMAL MATTERS AND CONCLUSION

In view of the foregoing amendments and remarks, Applicant respectfully submits that claims 1, 3-10, 12-15, 17-18, and 20-32, all the claims presently pending in the Application, are patentably distinct over the prior art of record and are in condition for allowance. The

Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the Application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Attorney's Deposit Account No. 50-0481.

Respectfully Submitted,

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